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10/076,120	02/12/2002	Feng Yang	122-2.1	8897

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EXAMINER

KERN, MATTHEW C

ART UNIT	PAPER NUMBER
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2654

DATE MAILED: 03/15/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

10/076,120

Applicant(s)

YANG ET AL.

Examiner

Kern, Matthew

Art Unit

2654

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☐ Responsive to communication(s) filed on ____.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-35 is/are pending in the application.
- 4a) Of the above claim(s) ____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) ____ is/are allowed.
- 6) ☒ Claim(s) 1-28 and 34 is/are rejected.
- 7) ☐ Claim(s) ____ is/are objected to.
- 8) ☒ Claim(s) 29-33 and 35 are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on ____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
- ☐ Certified copies of the priority documents have been received.
 - ☐ Certified copies of the priority documents have been received in Application No. ____.
 - ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|---|--|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413)
Paper No(s)/Mail Date. ____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152) |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)
Paper No(s)/Mail Date ____ | 6) <input type="checkbox"/> Other: ____ |

DETAILED ACTION

Election/Restriction

1. Restriction to one of the following inventions is required under 35 U.S.C. 121:
 - I. Claims 1-28, and 34, drawn to noise suppressor unit, classified in class 704, subclass 226.
 - II. Claims 29-32 and 35, drawn to voice activity detector (VAD), classified in class 704, subclass 233.

The inventions are distinct, each from the other because of the following reasons:

Inventions I. The noise suppressor unit and II. The VAD are related as combination and subcombination. Noise suppressor unit combination as claimed does not require the particulars of the subcombination as claimed for patentability, and (2) that the subcombination has utility by itself or in other combinations (MPEP § 806.05(c)). In the instant case, the combination as claimed does not require the particulars of the subcombination as claimed because any VAD could be used in the noise suppressor unit and still have the noise suppressor function as intended. The subcombination has separate utility such as a VAD for a speech-recognizer-based dictation apparatus.

Because these inventions are distinct for the reasons given above and have acquired a separate status in the art as shown by their different classification, restriction for examination purposes as indicated is proper.

Art Unit: 2654

During a telephone conversation with Mr. Truong Dinh on Tuesday, March 9, 2005 at 1:45 pm Eastern time, a provisional election was made **without traverse** to prosecute the invention of noise suppressor unit, claims 1-28 and 34. Affirmation of this election must be made by applicant in replying to this Office action. Claims 29-33 are withdrawn from further consideration by the examiner, 37 CFR 1.142(b), as being drawn to a non-elected invention.

Specification

2. The disclosure is objected to because of the following informalities:

In para [160], line 6 should read, --Wiener--, not "Weiner".

In para. [165], lines 1 and 5, "Gain Calculation unit 642b" should read --Gain Calculation unit 644b--.

In para [165], reference is made to equation 7 (line 7), but equation 7 is not listed until para. [168]. Then, in paragraph[168], Eq. 7 refers to the gain coefficients G3 (line 3), not G2 as discussed in para [165].

In para [167], line 2 should read --gain calculation unit 644b--, not "642b".

In para [170], line 3 should read, --This represents one way...--, eliminating the extra "is".

In para [172], line 5 should read, --...noise suppression unit 240...--, not "230".

3. A number of other errors like the aforementioned have been located, but will not be listed here for the sake of brevity. The examiner would like to remind the applicant that they are responsible for the proofreading and correction of any errors, including those discussed above and others not explicitly mentioned. Appropriate corrections are required.

Drawings

4. The drawings are objected to as failing to comply with 37 CFR 1.84(p)(5) because they include the following reference character(s) not mentioned in the description:

Figure 1a does not have microphone 110a (please refer to par[0022] for reference to microphone 110a), only sensor 110b. Corrected drawing sheets in compliance with 37 CFR 1.121(d), or amendment to the specification to add the reference character(s) in the description in compliance with 37 CFR 1.121(b) are required in reply to the Office action to avoid abandonment of the application. The objection to the drawings will not be held in abeyance.

Claim Objections

Claims 23,25, and 27 are objected to because of the following informalities:

The recitation of "multiplier configured to multiple magnitude of a transformed intermediate signal with the set of gain coefficients" (lines 9-11 of claims 23 and 25, and lines 6-8 of claim 27), is ambiguous. The examiner interprets it as, "multiplier configured to multiply the magnitude of a transformed intermediate signal with the set of gain coefficients."

Appropriate corrections are required.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

5. Claim 1-12,14-20,22-25 and 28 are rejected under 35 U.S.C. 103(a) as being unpatentable over Meyer et al (1997 IEEE), and further in view of Pollak et al. (Eurospeech, 1993).

As per claim 1, Meyer et al. teaches a signal processing system used in an automobile (car, title) to suppress noise (noise reduction, abstract) from a speech signal comprising:

Art Unit: 2654

- a signal processor (algorithm necessarily implies that a processor is used to implement the algorithm, pg 1168, heading 3. Algorithm) operatively coupled to the first and second signal detectors (figure 3) and configured to receive and process the first and second signals based on at least one noise suppression technique (spectral subtraction, figure 3) to provide an output signal ($y(t)$, figure 3) having a substantial portion of the desired component and a large portion of the undesired component removed.

- desired signal component includes speech (speech, title).

Meyer et al. teach neither a first signal detector configured to provide a first signal comprised of a desired component plus an undesired component, nor do they teach a second signal detector configured to provide a second signal comprised mostly of an undesired component. Pollak et al, however, teach a two-channel approach where the second channel is a noise reference channel (pg 1, para 2, lines 9-12) and the first channel has is the noisy speech signal (telephone used in a car, pg 1, para 1, lines 5-6). Therefore, it would have been obvious for one of ordinary skill at the time of invention to have Meyer et al.'s multi-channel noise suppression unit system be only dual channel (with one noise channel) so as to simplify the processing of noise suppression, as taught by Pollak et al.(page 1, para 1: introduction, lines 6-7).

As per claim 2, Meyer et al. teach a system where the first signal detector is a microphone configured to detect speech activity (speech pause detector detects speech, page 1169, figure 3).

As per claim 3, Meyer et al. do not teach a system where the second signal detector is a sensor configured to detect automobile vibration. Pollack et al., however, teaches a noise suppression system where the second signal detector is a sensor configured to detect automobile vibration (engine and car body vibrations, pg 1, heading 2. Chosen Methods). Therefore, it would have been obvious for one of ordinary skill at the time of invention to have one of the sensors in Meyer et al.'s speech system arranged so as to pick up automobile vibration so that this signal could be subtracted from a signal containing speech and vibration noise, leaving essentially the desired voice signal.

As per claim 4, Meyer et al. does not teach a system where the second signal detector is a sensor configured to detect mostly noise. Pollak et al, however, teach a second signal detector that is a sensor configured to detect mostly noise (noise reference signal and two-channel adaptive noise canceller, page 1, col 1, para [2], lines 9-12). Therefore, it would have been obvious for one of ordinary skill at the time of invention to include one of the noise-detecting sensors described by Pollak et al. in Meyer et al.'s system so that the noise could later be subtracted so as to suppress noise.

As per claim 5, Meyer et al. teach an adaptive noise canceller (ANC) configured to subtract the current noisy part of speech (clean speech signal power spectrum can

Art Unit: 2654

be estimated by subtracting the current noise power spectrum, as suggested by p1169, col 2, lines 18-19)

As per claim 6, Meyer et al. teach:

- a system where the adaptive canceller implements a least mean square algorithm (LMS) (adaptive wiener filter, figure 3, pg 1169).

Meyer et al. do not teach using a normalized LMS algorithm (NLMS). However, the examiner takes Official Notice that it is old and well-known in the art to use a NLMS algorithm because normalizing the error results in a better description of the error value in non-stationary signal or noise environment. Therefore, it would have been obvious for one of ordinary skill at the time of invention to modify the system of Meyer et al. to include NLMS capability so that the results could provide a better understanding of the significance of the residual noise level.

As per claims 7 and 8, Meyer et al. does not teach a system where the adaptive noise canceller is implemented in the time-domain. However, the examiner takes Official Notice that it is old and well-known in the art to implement filtering both in the time-domain and the frequency-domain. Therefore, it would have been obvious for one of ordinary skill at the time of invention to alternatively have the ANC of Meyer et al. implemented in the time domain, since there is no special advantage claimed for either choice. Either choice should work equally well.

As per claim 9, Meyer et al. teach a system wherein the signal processor (necessary to implement the multi-channel algorithm, abstract) further includes:

- a voice activity detector (speech pause detector, p1169, figure 3).
- an ANC to provide a control signal indicative of non-active time periods (implied, since noise is averaged only during noisy speech intervals, p1169, col 1, lines 28 and col 2, line 1).

As per claim 10, Meyer et al. teach a system wherein the signal processor includes:

- a noise suppression unit (spectral subtraction, which is a spectral modification technique used to suppress noise, figure 3) configured to receive the intermediate and second signal (arrow pointing from speech pause detector to spectral subtraction, figure 3) and to suppress the undesired component in the intermediate signal based on a spectrum modification technique (spectrum subtraction, figure 3) to provide an output signal having a substantial portion of the desired component and a large portion of the undesired component removed ($y(t)$), figure 3).

As per claim 11, Meyer et al. teach a multi-channel system (multi-channel, title), thus including a system wherein the noise suppression unit is configured to suppress the undesired component in the intermediate signal based on a two-channel spectrum modification technique using the first and second signals.

As per claim 12, Meyer et al. do not teach a system wherein the noise suppression unit is configured to suppress the undesired component in the intermediate signal based on a single-channel spectrum modification technique using the intermediate signal. Pollak et al., however teach this (One-channel spectral subtraction method, abstract; noise suppression system for a car, title). Therefore, it would have been obvious for one of ordinary skill at the time of invention to have Meyer et al's system accommodate for the single-channel spectrum modification technique because of its robustness, simplicity, and non-musical tone output, as taught by Pollak et al (abstract).

As per claim 14, Meyer et al. teach a system wherein the noise suppression unit (speech pause detector, spectral subtraction and Wiener Filter, p1169, figure 3) is configured to suppress the undesired component in the first signal in the frequency domain (FFT, p1169, figure 3).

As per claim 15, Meyer et al. teach a system that is configured for installation in a automobile (car environment, title).

As per claim 16, Meyer et al. do not teach a system where in the undesired component of the second signal there exists vibration noise. However, Pollak et al. teach a multi-channel signal separation method designed to reduce unwanted noise or vibration signals (engine and car body vibrations, p1, heading 2.Chosen Methods). It

Art Unit: 2654

would have been obvious for one of ordinary skill in the art at the time of invention to have Meyer et al's noise suppressor have as its second signal input vibration noise to cancel this type of low-frequency noise which is often encountered in car environments.

As per claim 17, Meyer et al. do not specifically teach a system wherein the undesired component includes engine noise and road noise. However, Pollak et al. teach a second signal corrupted by engine noise and vibrations from the car body (wherein the vibrations from the car body are caused by the noisy engine, pg 1, para 2. Chosen Methods). Therefore, it would have been obvious for one of ordinary skill at the time of invention to have the second channel of the noise suppressor of Meyer et al. to detect all car noise, including engine noise and road noise, to get rid of the most frequent noise sources.

As per claim 18, Meyer et al. teach a system wherein the desired component in the first signal is speech (speech enhancement, title, and figure 3, $x_0(t)$).

As per claim 19, Meyer et al. teach a signal processing system comprising:

- a voice activity detector (speech pause detector, figure 3) configured to receive the intermediate signal (from LP filter, figure 3) and provide a control signal (from speech pause detector to noise floor estimator, p1169, figure 3) indicative of non-active time periods whereby the desired component is detected to be absent from the intermediate

Art Unit: 2654

signal (noise floor estimation implies determining time periods when voice is not present, p1169, figure 3); and,

- an adaptive noise suppression unit (spectral subtraction, which is a spectral modification technique used to suppress noise, figure 3) configured to receive the intermediate and second signal (arrow pointing from speech pause detector to spectral subtraction, figure 3) and to suppress the undesired component in the intermediate signal based on a spectrum modification technique (spectrum subtraction, figure 3) to provide an output signal having a substantial portion of the desired component and a large portion of the undesired component removed ($y(t)$), figure 3).

The rest of the limitations were discussed in the rejection of claims 1 and 5 above.

As per claim 20, Meyer et al. teach a system wherein the adaptive canceller is configured to adaptively cancel the correlated portion of the undesired component based on a linear transfer function (a wiener filter is linear, pg 1169, figure 3).

As per claim 22, it is rejected for reasons given in the rejection of claim 11 above.

As per claim 23, Meyer et al teach :

- a gain calculation unit configured to receive the spectrum estimates and provide a set of gain coefficients; and a first multiplier configured to multiply a magnitude of a transformed intermediate signal with the set of gain coefficients (Meyer's frequency

Art Unit: 2654

domain Wiener filtering inherently determines gain coefficients by which to multiply the FFT magnitude of the noise or voice spectrum, pg 1169, figure 3).

- a noise spectrum estimator (noise floor estimation, pg1169, figure 3) configured to receive the intermediate and second signals and provide spectrum estimates of the desired component in the intermediate signal (clean speech power spectrum estimated by subtracting current noise power spectrum, p 1169, line 18-19) and the undesired component in the second signal (current noise power spectrum, p 1169, line 19).

As per claim 24, Meyer et al. do not teach a system wherein the noise suppression unit is configured to suppress the undesired component in the intermediate signal based on a single-channel spectrum modification technique using the intermediate signal. Pollack et al., however teach this (One-channel spectral subtraction method, abstract and noise suppression system for a car, title). Therefore, it would have been obvious for one of ordinary skill at the time of invention to have Meyer et al's system accommodate for the single-channel spectrum modification technique because it of its robustness, simplicity, and non-musical tone output, as taught by Pollak et al (abstract).

As per claim 25, it recites the same or similar limitations as claim 23, so it is rejected for the same reasons.

As per claim 28, Meyer et al. teach a system configured for installation in an automobile (car, title).

6. Claim 13 is rejected under 35 U.S.C. 103(a) as being unpatentable over Meyer et al. and Pollak et al as applied claim 1 above, and further in view of Boll (1979 IEEE).

Meyer et al. do not teach this noise-suppressing unit being able to suppress residual noise. Boll, however, teaches a noise suppression unit that is configured to suppress a residual undesired component (residual noise reduction, p 115, col 1, section g.: Residual Noise reduction) in the first signal. Therefore, it would have been obvious for one of ordinary skill at the time of invention to include this residual noise-suppression capability in the noise suppression unit of Meyer et al.

Further, Meyer et al. do not teach reducing this residual noise component in the first signal based on a status of a voice activity detector. However, Boll teaches this (detecting the absence of speech, section H. Additional signal attenuation during non-speech activity, line 7-8). Therefore, it would have been obvious for one of ordinary skill at the time of invention to have the noise suppression unit of Meyer et al. and Pollak et al. suppress residual noise based on the output of a VAD as described by Boll since he teaches that doing nothing was found to have the same effect of amplifying the noise during non-speech activity (pg 115, section H), and this way, the noise suppressor unit

Art Unit: 2654

would "know" when no one is speaking, and suppress the residual noise, in the manner taught by Boll.

7. Claim 21, 26, and 27 are rejected under 35 U.S.C. 103(a) as being unpatentable over Meyer et al. and Pollak et al as applied claim 19 above, and further in view of Boll (1979 IEEE).

As per claim 21, Meyer et al. and Pollak et al. do not teach a system wherein the adaptive canceller is configured to adaptively cancel the correlated portion of the undesired component based on a nonlinear transfer function. Boll, however, teaches this (bias removal and half-wave rectification, pg 114, section F. heading). Therefore, it would have been obvious for one of the ordinary skill at the time of invention to use a non-linear transfer function in the ANC of Meyer et al. and Pollak et al. because Boll teaches that this reduces the noise floor (p 115, section F, lines 2-3).

As per claim 26, Meyer et al. teach a system with a noise suppression unit (spectral subtraction block and speech pause detector/ noise floor estimation block, figure 3) that performs spectral analysis on an intermediate signal (the spectral subtraction technique inherently works by performing spectral analysis). Meyer et al. do not teach suppression of an undesired residual component in the first signal using the aforementioned intermediate signal. Boll, however, teaches residual noise reduction (residual noise reduction, p115, column G). Therefore, it would have been obvious for

one of ordinary skill at the time of invention to have the residual noise reducer of Boll act on the intermediate signal produced by Meyer so that any background noise can be further reduced. As a result, when one speaker is not talking, the person on the other end will not hear any noise.

As per claim 27, it recites the same or similar limitations as claim 23, and so is rejected for the same reasons.

8. Claim 34 is rejected under 35 U.S.C. 103(a) as being unpatentable over Meyer et al. and Boll.

Meyer et al. teach a method for suppressing noise in an automobile, comprising:

- removing the undesired component in the first signal based on spectrum modification (spectral subtraction, figure 3) to provide an output signal (y(t), figure 3) having a substantial portion of the desired component and a large portion of the undesired component removed.

Meyer et al. do not teach removing an additional portion of the undesired component in the first signal based on spectrum modification to provide an output signal. Boll, however, teaches this (Residual noise reduction , pg 115, section G). Therefore, it would have been obvious for one of ordinary skill at the time of invention to include in Meyer et al. the ability to reduce residual noise as taught by Boll so that when one speaker was not speaking, the other person at the other end would not hear noise.

The rest of limitations were discussed in connection with the rejection of claim 19 above.

Conclusion

9. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure.

Anderson et al (US patent 6,453,285) teach a VAD in a noise suppressing device with the VAD providing input into the speech spectrum estimator, whose signal is then fed to a spectral gain generator, which is then fed to a multiplier.

Isabelle (US patent 6,122,610) teach a speech/pause detector whose output feeds into a noise spectrum estimator, whose output is then fed into a spectral gain computation block.

Nakaji et al (US patent 5,416,844) teach a noise suppression system with filter coefficients and transfer functions.

Hamabe et al. (US patent 5,426,703) teach detecting residual noises with microphones.

Coker et al. ("A nonlinear adaptive noise canceller", IEEE 1980) teach a nonlinear noise canceller.

Rosenthal et al.(US Patent 5,917,919) improves on the Wiener filter concept.

Picket (US Patent Application Publication 2002/0152066) teach a VAD, Noise content estimator, and a channel gain cancellation block.

Art Unit: 2654

Harrison et al (1984 IEEE) teach an adaptive noise suppressor(ANC) in a dual channel noise suppression system.

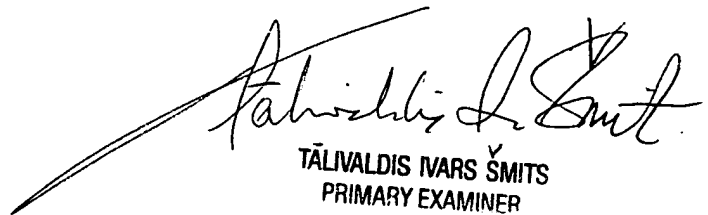
10. Any inquiry concerning this communication should be directed to Mr. Matthew Kern, whose telephone number is (703) 305-4828 or fax number (703) 305-9508. The examiner can normally be reached Mondays-Fridays from 9:30 am to 6 pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Dr. Talivaldis Smits, can be reached at (703) 306-3011. The facsimile phone number for this Technology Center is (703) 305-9508.

Any inquiry of a general nature of relating to the status of this application should be directed to the Technology Center 2600 receptionist, whose telephone number is (703) 746-6055.

3/8/05

MCK



TĀLIVALDIS IVARS ŠMITS
PRIMARY EXAMINER